DOCUMENT RESUME

ED 030 113 AL 001 969

By-Schank, Roger C.

Linguistics from a Conceptual Viewpoint (Aspects of Aspects of a Theory of Syntax).

Stanford Univ., Calif.

Spons Agency-Department of Defense, Washington, D.C. Advanced Research Projects Agency.; National Inst. of Mental Health (DHEW), Bethesda, Md.

Report No-MEMO-AI-88

Pub Date 21 Apr 69

Note-23p.

EDRS Price MF-$0.25 HC-$1.25

Descriptors-Child Language, Cognitive Processes, Computational Linguistics, *Concept Formation, *Language Universals, *Linguistic Competence, Linguistic Performance, *Linguistic Theory, Models, Semantics, Syntax, *Transformation Generative Grammar

Identifiers-*Aspects Of The Theory Of Syntax, Chomsky Noam, Conceptual Parser, Stanford Artificial Intelligence Project

Some of the assertions made by Chomsky in "Aspects of the Theory of Syntax" are considered. In particular, the notion of a "competence" model in linguistics is criticized. Formal postulates for a conceptually-based linguistic theory are presented. (Author/JD)

ED030113

STANFORD ARTIFICIAL INTELLIGENCE PROJECT
MEMO AI-88

April 21, 1969

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY.

Linguistics from a Conceptual Viewpoint

(Aspects of Aspects of a Theory of Syntax)

by

Roger C. Schank

ABSTRACT: Some of the assertions made by Chomsky in Aspects of the Theory of Syntax are considered. In particular, the notion of a 'competence' model in linguistics is criticized. Formal postulates for a conceptually-based linguistic theory are presented.

This research is supported by Grant PHS MH 06645-07 from the National Institute of Mental Health, and (in part) by the Advanced Research Projects Agency of the Office of the Secretary of Defense (SD-183).

AL 001 969

Linguistics from a Conceptual Viewpoint

(Aspects of Aspects of a Theory of Syntax)

1. Although linguistics is often referred to as the 'science of language', it has been usual for linguists to resist this label and its concomitant expectations. With the exception of the attempts of Bloch (1948) and Bloomfield (1926) at establishing postulates for language, the formalization that is often present in a science was difficult to find before 1957. With the advent of transformational generative grammar however, the direction of the bulk of linguistic research changed considerably. Linguists who are in the transformational camp tend to be more concerned with precision and formalization than was common in the past.

It is perhaps enlightening to attempt to discover just how valid the assumptions that have led to the present conception of transformational

grammar are; and, if they are not valid, a good question is just what assumptions might be considered valid.

Initially, transformational theory dealt only with kernels and transforms. The kernels were the output of the PSG and certain obligatory transformations. Thus a transformational grammar was simply a specification of the permutations involved in correcting the output of a PSG. This system was still used until it became clear that it was insufficient to handle all the complexities involved in natural language.

Bach (1964) stated that 'The minimal requirement that we can place on a theory about a particular language is that it specify or predict all and only the sentences of the language'. Until this time, these were precisely the requirements that were placed on a transformational grammar. However, two important problems resulted from this view of what a linguistic theory was to accomplish. The first was that the system of phrase structure grammar and the transformations that were added simply did not account for all the sentences of English. The second problem is that the system as it stood could not be extended to other languages without completely revamping both components in such a way that the two grammars would be very dissimilar. This clearly is in contradiction to a fact of language that we know very well. Namely, than any baby possesses the mechanisms to learn any language and that therefore, there must be some similarity between languages. Furthermore, this similarity should pervade the grammars of different languages such that things like translatability can be explained.

Thus it appeared obvious that an important step towards solving both the first and second problems would be the positing of a Universal grammar that would hold for all languages and a particular grammar for each language. Therefore, since the framework was already available, the phrase

structure component began to be utilized as the basis for a universal base component. (As Robinson [1968] points out this was a relatively arbitrary decision.) At this point Chomsky's Aspects of the Theory of Syntax appeared.

2. In Chapter I of Aspects, Chomsky sets down the 'main background assumptions' of transformational theory. It is worthwhile to examine some of these assumptions in detail.

The first and perhaps most important assumption that he makes is the 'fundamental distinction between competence (the speaker-hearer's knowledge of his language) and performance (the actual use of language in concrete situations) [p.4] that he sets up.

This distinction between competence and performance provides for transformationalists the platform from which to make their statements about transformations. Chomsky includes in his discussion of what a 'performance' model should do, factors such as memory limitations, inattention, distraction and non-linguistic knowledge. He thus leaves for 'competence' the formalization of linguistic processes representative of the speaker-hearer's knowledge of the language.

This relegation of competence makes a basic mistake however. It is necessary to differentiate the problem of formalization of linguistic knowledge and processes, i.e., competence, from the simulation of linguistic knowledge and processes. This simulation is not and cannot be labeled as what Chomsky would call 'performance'. There is a difference between the simulation of knowledge and processes and the simulation of actual verbal behavior. It is here that we must speak, as Chomsky does, of the ideal speaker-hearer. Clearly the ideal speaker-hearer is not inattentive or distracted. He does however have memory limitations and non-linguistic knowledge. This is certainly what must be simulated as an inclusive part of linguistic theory. The kind of theory of 'performance' of which Chomsky speaks may well be in the far distant future to which Chomsky relegates it. However, a theory of simulative performance is not so far off. It would

seem very reasonable that the possibility of the construction of a linguistic theory that both accounts for the data and does this in such a way as to appear to be consonant with the human method for doing so, is not so remote. Clearly, such a theory must deal with non-linguistic knowledge and problems of human memory as well as the problems that Chomsky designates as 'competence'. Thus, it seems that the distinction between competence and performance is a contrived one at best. In particular, after elimination of some of the behavioristic problems such as distraction, we can expect to find a linguistic theory that is neither one of 'competence' or 'performance' but something in between and therefore partially inclusive of both.

On Page 139 Chomsky states:

> Thus it seems absurd to suppose that the speaker first forms a generalized Phrase-marker by base rules and then tests it for well-formedness by applying transformational rules to see if it gives, finally, a well-formed sentence. But this absurdity is simply a corollary to the deeper absurdity of regarding the system of generative rules as a point-by-point model for the actual construction of a sentence by a speaker.

The system presented in a theory of simulative performance, on the other hand, would be an attempt at formulating a system of rules that are a point-by-point model for the actual construction of a sentence by a speaker. Furthermore, this system should be a point-by-point model for the actual analysis of a sentence by a hearer. These aims even if they are attainable would be largely unverifiable except by the use of computers as simulative devices.

On page 141 Chomsky further states that:

> The grammar does not, in itself, provide any sensible procedure for finding the deep structure of a given sentence, or for producing a given sentence, just as it provides no sensible procedure for finding a paraphrase to a given sentence. It merely defines these tasks in a precise way. A performance model must certainly incorporate a grammar; it is not to be confused with a grammar.

Thus it would be wise to take the notion of a simulative performance model as being somewhere between Chomsky's notion of competence and performance. Perhaps the notion of grammar too, should lie somewhere between Chomsky's notion of a grammar and the incorporation of a grammar.

Chomsky describes a grammar of a language as 'a description of the ideal speaker-hearer's intrinsic competence' [p.4] and calls this a 'generative grammar'. It is reasonable to consider whether a 'generative grammar' in a large sense might also concern itself with describing what Chomsky calls 'competence', but in a way in which the ideal speaker-hearer does so; in particular without excluding such important considerations as the speaker-hearer's knowledge of the world.

Now it is possible to redefine the notion of a 'fully adequate grammar'. Chomsky would have a fully adequate grammar 'assign to each of an infinite range of sentences a structural description indicating how this sentence is understood by the ideal speaker-hearer [p.5]. However, the structural description employed by Chomsky and therefore by transformational grammar is syntactic in nature and there is some question as to whether syntactic descriptions reflect at all how a sentence is understood by the speaker-hearer. It would seem that although the goal of a 'fully adequate grammar' is to the point, the method by which Chomsky arrives at this grammar, and

therefore the grammar itself, is clearly not. That is, when Chomsky states that 'a grammar is descriptively adequate if it generates the correct set of structural descriptions' [p. 60] it is reasonable to ask what makes a set of structural descriptions 'correct'. Since a transformational grammar attempts to be justified at the level of descriptive adequacy, we can assume that to Chomsky a 'correct' structural description includes the notion of what the Noun Phrase, Verb Phrase, and for that matter, the dummy symbol to be found in the structural description are. If 'correct' for Chomsky does include only a competence grammar then it must be clear that the structural description provided by it does not explain how a speaker-hearer goes about understanding a sentence and that this problem does not belong to a performance grammar. The needed grammar must be in between Chomsky's extremes and the structural descriptions that it provides must be in terms of items more familiar to the speaker-hearer than 'dummy symbol'.

Thus, Chomskys 'fundamental distinction' between 'competence' and 'performance' is fundamental only insofar as one would want to develop a competence grammar. Although Chomsky may have done an adequate job of providing the basis of a competence grammar, the question remains as to what the point of such a grammar is. Chomsky states that linguistic theory is mentalistic in that it is concerned with discovering a mental reality underlying actual behavior [p.4]. However, results have been largely negative when attempts to prove the psychological validity of this competence grammar have been made. Fodor and Garrett (1966;151) comment:

> What is one to make of such negative findings? The simplest move would be to deny the validity of the experimental procedures... If one is to deny the validity of such procedures in cases where they appear to fail, it seems one will equally have to deny their

> validity in the cases where they appear to succeed. It is in any event now conceivable that enough negative data will eventually accumulate to make one wonder whether it is the theory that is at fault rather than the experiments. ...it is a mistake to claim psychological reality for the operations whereby grammars generate structural descriptions.

Thus, even transformationalists recognize that their theory does not make any verifiable psychological claims.

If a competence grammar is not useful for explicating psychological processes what other purpose could it have? It seems to me that the purpose of a linguistic theory is somehow more than just explaining things about language. What Chomsky refers to as "traditional linguistics" explained a great deal about language, but Chomsky and his followers have deemed this insufficient. It is hard for me to see how formalization for its own sake would make these explanations sufficient. A generative grammar should account for psychological processes and as long as this is unverifiable, the formalization techniques presented by a generative grammar should be useful in any sense that they might be needed. Clearly they are needed in computational linguistics. But transformations have consistently been very difficult to reverse for parsings. Even if they were reversable the output would be syntactic, since it is the syntactic component of a transformational grammar that accounts for generative capacity. The question remains as to whether syntactic information, even meaning-oriented syntactic information, such as deep structures, can account for understanding. That is, is underlying competence significant? In particular, would a model of simulative performance not be somewhat more meaningful, at least from a psychological and computational point of view?

3. On page 24 Chomsky notes that 'we must be careful not to overlook the fact that surface similarities may hide underlying distinctions of a fundamental nature, and that it may be necessary to guide and draw out the speaker's intuition in perhaps fairly subtle ways before we can determine what is the actual character of his knowledge of his language or of anything else. He notes that 'the latter (point) is as old as Plato's Meno'.

Clearly, the method employed by Socrates in The Meno for drawing out one's actual knowledge is basically fallacious both with respect to the problem of geometry in The Meno and with respect to language. The slave boy questioned by Socrates is clearly being taught. It is hard to believe that the knowledge eventually displayed by the slave boy was there from another life, but rather it is easy to detect the teaching method that Socrates employs. For determing the actual knowledge of a patient in a psychiatric interview the Socratic method is certainly worthwhile. This is so precisely because the information being sought is definitely present. Clearly, this is not the case in questioning a young boy about geometry. What actually does happen is that certain implications of already present knowledge are brought to the surface.

Chomsky would have us believe that this process would be valid in linguistics. One can imagine a Socratic conversation that attempts to bring to the surface the supposedly already present knowledge that sentences are constructed with noun phrases as component parts. It is necessary to distinguish here between the actual knowledge and a description of that knowledge. Clearly, sentences can be described in terms of noun phrases. However, it is difficult to convince a speaker that he actually rewrites an S as an NP VP. From a descriptive point of view these NP's and VP's may be considered to be present. They are not, however, very likely to be part

of the actual knowledge of the speaker. Thus, the notion of the speaker's intuition is a somewhat tenuous one. As was shown by Socrates' attempts, the speaker's intuition is exactly that which the questioner wishes it to be. Thus, if we draw out the speaker's intuition in a 'fairly subtle' enough way such as to elicit the fact that there is an NP present in all of the sentences that he utters, it is unclear exactly what we have accomplished. Certainly this cannot be the basis for a linguistic theory that does any more than describe the data. This description may be nice to have but it does not tell us anything about the actual process of language.

At this point numerous transformationalists are liable to object that all a transformational grammar is supposed to do is describe the data. If this is the case, one is prone to ask why one is concerned with the speaker's intuition at all, and in particular how is it possible to justify a statement such as the following from Chomsky's Beckman Lectures at Berkeley (1967:III:9):

> We cannot avoid being struck by the enormous disparity between knowledge and experience - in the case of language, between the generative grammar that expresses the linguistic competence of the native speaker, and the meager and degenerate data on the basis of which he has constructed this grammar for himself.

Here Chomsky equates 'knowledge' with a generative grammar. Thus it would appear to be the case that despite protestations to the contrary, Chomsky believes that people's knowledge of language is in fact a generative grammar. That is, a generative grammar is not intended to be a description of his knowledge but his actual knowledge. Yet the information for this grammar can be derived from the somewhat tenuous framework of the Socratic method! The results of this approach are further lauded when Chomsky notes

(1967:III:5)

> that if success is achieved in constructing empirically adequate generative grammars and determining the universal principles that govern their structure and organization, then this will be an important contribution to human psychology.

One wonders if the method for determining universals is akin to some large scale drawing out of the speaker's intuition. Certainly it is doubtful if the process used by Socrates in The Meno was an important contribution to human psychology (although it certainly may have been to pedagogy and philosophy). One wonders, how a supposedly descriptive device such as a generative grammar formed in the above ways can contribute at all to describing how a human does what he does when he speaks language.

4. The notion of a descriptive grammar, if it were intended to be only that, would not be particularly bothersome. However, it would appear that although Chomsky continually refers to just a descriptive grammar, he is just as continually implying that he is seeking more than this. Consider for example, a statement of Chomsky's taken from his discussion of universals. (p. 30)

> Formal constraints...on a system of concepts may severely limit the choice (by the child, or the linguist) of a descriptive grammar, given primary linguistic data.

The parenthetical remark is most revealing. Chomsky seems to be implying that there is some correlation between the selection of a grammar by the child and by the linguist. Yet, if the linguist is supposed to be constructing a 'descriptive grammar', that is, one that only describes the data of the language in some way, the child must be doing this also. This seems hard to believe. Can the child be said to be constructing a description of the data that he has gathered? Somehow this notion seems unlikely. In fact, if this were the case, there would be no need for any other notion of a grammar besides a descriptive one. Yet, Chomsky consistently maintains that a transformational grammar is not intended to be 'a point-by-point model for the actual construction of a sentence by a speaker' (p. 139). But it is clearly the case that a child is constructing a grammar which is exactly a procedure for the point-by-point construction of a sentence in his own head. Certainly, it is this procedure that is the child's grammar. This is not a descriptive grammar in the sense that Chomsky intends it. Thus, there is some question as to how it is possible for Chomsky to make the statement that he does make on page 30.

The confusion that Chomsky allows here has led to a great many

problems with respect to just what transformational grammars are and what it is they can do. This confusion muddles not only his followers but Chomsky himself. Consider for example, the paragraph following the quote on page 30.

> The existence of deep-seated formal universals, in the sense suggested by such examples as these, implies that all languages are cut to the same pattern, but does not imply that there is any point-by-point correspondence between particular languages. It does not, for example, imply that there must be some reasonable procedure for translating between languages.

Certainly there is a reasonable procedure for translating between languages since people do it all the time. What Chomsky means here is that the descriptive grammar that he is constructing may not provide that procedure. In fact, after many attempts it has become clear that a transformational grammar will not provide that procedure. But certainly that procedure exists. It is necessarily implicit in the point-by-point procedure that the child discovers for construction of a sentence. Thus, a procedure for translating between languages should be available as soon as a grammar of the point-by-point model that Chomsky seems so willing to disregard is available. This model would necessarily be founded on what Chomsky chooses to call substantive universals. That is, whatever is present in all languages, or underlying all languages, should form the basis (and in fact does) for translating between languages. However, the presence of formal universals in a linguistic description implies very little. It is a formal universal of the room in which I am sitting and therefore all rooms that if I paint everything in the room purple, all things in the room will be purple. It may be a formal universal of language that if one generates the basis of a

sentence and then permutes the output with enough special transformations and ad hoc constraints that a language can be described by this process. The question is whether this is at all meaningful.

5. Perhaps it is unfair, in a discussion of this kind, to harp on what is wrong with a theory without explaining what might be right. It should be clear from what has been said so far, that it is a theory of simulative performance that would satisfy my aims for linguistics. It would seem to me that this theory would have to be semantics-based. That is, it would, as do humans, start with beliefs (or meaning) inherent in a discourse, and then try to generate the discourse. To do this, it would probably be necessary to pass through some version of syntax along the way.

This generative theory would also employ a Universal and Particular grammar, but one that keeps each phase separate from the other. For example, Chomsky states that the sentence 'The harvest was clever to agree' violates certain 'rules of English' (p. 76). We would require that a theory of simulative performance find this sentence in perfect accord with the rules of English but discordant with the conceptual rules of the Universal component.

6. It is my purpose here to explicate what the point of a linguistic formalization might be, and to give some definitions of the elements needed in that formalization.

My underlying assumption here is that language is conceptually-based. By that I merely intend to emphasize the fact that language and throught are related, very much so in fact. Thus, it is possible to view the problem of formalization of language as the problem of the formalization of the underlying conceptual basis of language. Therefore, the rules that would be used for this formalization would explicate the elements of the conceptual process and then relate the output of that process to language.

Of course, the main problems in an attempt of this kind are determining what is meant by the conceptual process and how one can be able to view that process. The answer is that we cannot know for certain that our formalization is representative of the method that humans employ, but we can know if the output of the conceptual apparatus that humans employ is the same as the output of the formalization.

The following, then, are some basic definitions necessary to the formalization of the conceptual basis for language. They are the definitions that are used as the basis of a computational parsing system for natural language that extracts the language-free conceptualizations inherent in a piece of discourse. (This 'conceptual parser' is currently operating at the Stanford Artificial Intelligence Project. [see Schank and Tesler (1969)])

Formal Postulates and Definitions

The Conceptual Basis of Language

1) The basic unit of language is the conceptualization.

   a) A conceptualization is a language-free proposition expressing a relation between a linguistic concept that is an actor or a conceptualization, and an action and the object of that action.

   b) A linguistic concept with respect to an actor or object, consists of a bundle of descriptive attributes that define at what point the notion of the concept of that actor or object is complete in a given language. Linguistic concepts are language-free insofar as they have conceptual referents. Each language may define a linguistic concept at any point that it chooses and translatability between linguistic concepts in different languages can be said to be a function of the number of descriptive attributes needed to be added in order to have equivalence.

   c) An actor (denoted PP) is a category of linguistic concept that performs certain actions. In a conceptualization an actor may have a relation to another actor or to a descriptor instead of performing an action.

   d) An object is an actor that is not acting but rather is being acted upon in a given situation. Thus an object is also denoted PP and is capable of performing an action simultaneously.

   e) An action is a linguistic concept that corresponds to any real world action.

   f) A relation is defined as a dependence between two linguistic concepts. A dependence denotes that the dependent is adding information to

the governor. There are 8 types of dependence.

1) Two-way dependence (⇔) a two-way dependence is necessary in order to have a conceptualization. This dependency denotes that the governor-dependent relationship is mutual and that the connected concepts are adding information to each other.

2) Objective dependency (←). This dependency is reserved for objects of actions. The object may be a PP or a conceptualization.

3) Attributive dependency (↑). Here an attribute of the governor is explicated.

4) Prepositional dependency (⇐). This dependency gives information as to the recipient of an action.

5) Attributive prepositional dependency (⇑). This dependency explicates attributes about a PP as opposed to those parts of a PP.

6) Causal dependency. The dependency between two conceptualizations when one is the cause of the other.

7) Conditional dependency. The dependency between two conceptualizations when the truth of one is dependent on the truth of the other.

8) Attributive two-way dependency. An entire conceptualization serves attributively.

2) The Syntax of language consists of rules of relation within a conceptualization.

a) The syntax of language (as opposed to the syntax of a language) is not an expression of the so-called natural order of ideas, but rather is an expression of the possible relations between classes of concepts. Thus, the syntax of all languages is the same at the

level of conceptualization. The syntax consists of <u>conceptual categories</u> and their possible relations.

b) The categories of a linguistic system are (parenthesized expression corresponds to section number above):

1) (1c) PP

2) (1d) PP

3) (1e) ACT

4) PA, a descriptor of PP's

5) AA, a descriptor of ACT's

6) LOC, the location of a conceptualization

7) T, the time of conceptualization

c) The possible relations between these categories are:

1) (1f1) PP ⇔ ACT; PP ⇔ PP; PP ⇔ PA; ⇔ $\overset{PA}{\{ACT\}}$

2) (1f2) ACT ← PP ACT ←

3) (1f3)

PP	ACT	⇔	⇔	PA	PA	AA
↑	↑	↑	↑	↑	↑	↑
PA	AA	LOC	T	PA	AA	AA

4) (1f4) ACT ⇐ PP + (indicates that this dependence can be multiple)

5) (1f5) PP

PP

3) The <u>Semantics</u> of language is defined as the rules that permit a relation to exist. Thus, although the universal syntax may permit a given dependency, that dependency cannot exist unless the universal semantics also permits it. The semantics consists of <u>semantic files</u> associated with each possible conceptual governor in a conceptual relation for specific concepts and for <u>semantic categories</u>.

a) A semantic category represents a node in a hierarchical tree that divides the universe of physical objects. The tree branches every

time a descriptive attribute can modify a part of a semantic category without being able to modify the complementary part of that semantic category.

b) A semantic file consists of the list of descriptive attributes obtained by starting at a node in the hierarchical tree and tracing up. A semantic file exists for each possible dependency.

c) A specific concept is defined by the possible dependent conceptual categories and their associated semantic files. In each of the associated semantic files specific attributes are filled with respect to each descriptive attribute for each specific concept.

4) The Realization Rules of a language are the language specific rules of the linguistic system. These rules map parts of a conceptualization into an acceptable linguistic construct. The Realization Rules serve to define what an acceptable linguistic construct is, in the concept-to-word phase; and serve to recognize a linguistic construct in terms of its conceptual realizate in the word-to-concept phase. The Realization Rules are reversible and thus are the same in analysis and synthesis. However, in the actual use, the Realization Rules are only partially used for understanding (in order to disambiguate), while they are used in toto for generation.

7. The definitions presented here represent assertions about the character of language. They are also the basics of a computational linguistic system described in Schank (1969).

I share Chomsky's belief that 'the real problem for tomorrow is that of discovering an assumption regarding innate structure that is sufficiently rich' (1967:III:10). Many of the notions that are offered to us by transformational grammar regarding the universal grammar that would be a part of this rich innate schema are valuable. However, it seems to me that this universal grammar is conceptually based and thus must conform, to a large extent, to the postulates that I have presented here. That is, we must begin to speak of describing what is going on inside the child and not inside the linguist.

References

Bach, Emmon. 1964. An Introduction To Transformational Grammar. New York, Holt, Rinehart and Winston.

Bloch, Bernard. 1948. A Set of Postulates for Phonemic Analysis. Lg. 24.3-46.

Bloomfield, Leonard. 1926. A Set of Postulates for the Science of Language. Lg.2.153-64.

Chomsky, Noam. 1967 . Linguistic Contributions to the Study of Mind. Beckman Lectures, Berkeley.

Chomsky, Noam. 1965. Aspects of the Theory of Syntax. Cambridge, M.I.T. Press.

Fodor, J., and Garrett, M. 1966. Some Reflections on Competence and Performance. Psycholinguistics Papers, ed. J. Lyons, and R. Wales. Edinburgh, University Press.

Robinson, Jane. 1968. Dependency Structures and Transformational Rules. Specification and Utilization of a Transformational Grammar 3, ed. by Warren J. Plath. Yorktown Heights, I.B.M.

Schank, Roger. 1969. A Conceptual Dependency Representation for a Computer-Oriented Semantics. Ph.D. Thesis, University of Texas, Austin. Stanford Artificial Intelligence Project Memo 83, Stanford, Computer Science Department, Stanford University.

Schank, Roger and Tesler, Lawerence. 1969. A Conceptual Parser for Natural Language presented to First International Joint Conference on Artificial Intelligence, Washington, D.C., May 7-9, 1969.